

# PATENT ABSTRACTS OF JAPAN

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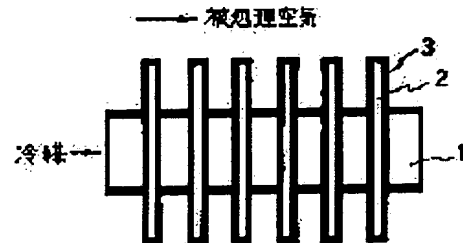
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## (54) DRY DEHUMIDIFIER

### (57)Abstract:

**PURPOSE:** To provide a dry dehumidifier capable of preventing the overheating of an adsorbent even when a high-humidity air is dehumidified, capable of obviating the lowering of adsorption efficiency and without need to raise the regenerating temp.

**CONSTITUTION:** Plural fins 2 are provided on the outside of a copper tube 1, and a moisture adsorbent 3 is applied on the tube 1 and fin 2. The air to be treated is circulated outside this heat-exchange member, and a refrigerant is circulated inside the tube 1.



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## CLAIMS

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[Claim(s)]

[Claim 1] The dry type air dryer characterized by making said one front face of the heat exchange member by which water adsorption material has been arranged on one front face carry out conduction of the processed air, and carrying out conduction of the thermal fluid on the surface of others.

[Claim 2] The dry type air dryer characterized by arranging water adsorption material into the outside-surface part of a tubed heat exchange member, carrying out conduction of the processed air to this outside-surface side, and carrying out conduction of the thermal fluid inside said heat exchange member.

[Claim 3] The dry type air dryer characterized by having the control means to which the adsorption material playback process to which the conduction of the warm temperature intermediation is made to carry out inside at least two tubed heat exchange members which have arranged water adsorption material into the outside-surface part, and the dehumidification processes which carry out conduction of the processed air to the outside-surface side of said heat exchange member, and carry out conduction of the refrigerant to the inside to these heat exchange members and said heat exchange members is made to carry out by turns.

[Claim 4] Said adsorption material is a dry type air dryer given in claim 1 characterized by being at least one sort chosen from the group which consists of silica gel, a zeolite, and an activated alumina thru/or any 1 term of 3.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to a dry type air dryer effective in especially dehumidification of high humidity air about the dry type air dryer dehumidified from processed air

using adsorption material.

[0002]

[Description of the Prior Art] There are a wet air dryer from which air is cooled and supersaturated vapor is removed as an air dryer from which the moisture in air is removed, and a dry type air dryer which moisture is made to stick to adsorption material and attains low humidity-ization. In a wet air dryer, what cools air using the refrigerant cooled with the refrigerator is common.

[0003] However, this refrigerator has the trouble that consumption energy is high, in order that it is going to be contrary to the request of the latest dechlorofluocarbon since chlorofluocarbon is used, and the heat of condensation may carry out [ and ] condensation clearance of the large moisture. Moreover, in order to prevent \*\*\*\*-ization of the condensed moisture, there is a difficulty that constraint is in cooling temperature and a dehumidification field.

[0004] On the other hand, since a water adsorption operation of adsorption material, such as silica gel, removes the moisture in air in a dry type air dryer, there is no constraint in the dehumidification field which it is going to apply. For this reason, Field of application has expanded this dry type air dryer in recent years.

[0005]

[Problem(s) to be Solved by the Invention] However, since the adsorption reaction of moisture is a thing accompanied by big generation of heat when it applies to dehumidification of high humidity air, the conventional dry type air dryer has the trouble that the processed air itself will become an elevated temperature. Thus, since adsorption material generates heat by adsorption of moisture, it will become an elevated temperature and adsorption effectiveness will fall. Moreover, since it is necessary to let hot resurgent gas pass to adsorption material rather than processed air in order to reproduce adsorption material, a hot heat source is needed for resurgent gas, and there is a difficulty that a running cost is high.

[0006] Also when this invention is made in view of this trouble and it dehumidifies high humidity air, while being able to prevent the fault temperature up of adsorption material and being able to prevent decline in adsorption effectiveness, it aims at offering the dry type air dryer to which regenerating temperature can be reduced as compared with the former.

[0007]

[Means for Solving the Problem] The dry type air dryer concerning this invention is characterized by making said one front face of the heat exchange member by which water adsorption material has been arranged on one front face carry out conduction of the processed air, and carrying out conduction of the thermal fluid on the surface of others.

[0008] Moreover, other dry type air dryers concerning this invention are characterized by arranging water adsorption material into the outside-surface part of a tubed heat exchange member, carrying out conduction of the processed air to this outside-surface side, and carrying out conduction of the thermal fluid inside said heat exchange member.

[0009] Furthermore, the dry type air dryer of further others concerning this invention At least two tubed heat exchange members which have arranged water adsorption material into the outside-surface part, It is characterized by having the control means to which the adsorption material playback process of making the conduction of the warm temperature intermediation carrying out to the dehumidification process which carries out conduction of the processed air to the outside-surface side of said heat exchange member, and carries out conduction of the refrigerant to the inside inside said heat exchange member is made to carry out by turns to these heat exchange members.

[0010]

[Function] the side (a 1 front-face side or outside-surface side) by which the water adsorption material of a heat exchange member has been arranged at the dehumidification process in this invention -- it is going to dehumidify -- conduction of the processed air is carried out, and the moisture in processed air is made to stick to said adsorption material, and is dehumidified. On the other hand, conduction of the thermal fluid is carried out to the front-face side of everything but a heat exchange member, or the inside, and heat is taken from said adsorption material through a heat exchange member. It is prevented that the adsorption material which generated

heat by the adsorption reaction carries out temperature up too much by this. For this reason, since it is not necessary to make regenerating temperature into an elevated temperature like before while being able to prevent decline in the adsorption effectiveness of adsorption material, the running cost of the heat source of resurgent gas can be reduced.

[0011]

[Example] Hereafter, the example of this invention is concretely explained with reference to an attached drawing. Drawing 1 is the front view showing the heat exchange member of the dry type air dryer concerning the example of this invention. Fitting of two or more aluminum plate fins 2 is carried out to the heat exchange tubing (copper tube) 1. And the water adsorption material 3 is arranged all over the peripheral face of these copper tubes 1, and the front face of a fin 2. This adsorption material 3 can apply an acrylic adhesiveness binder all over the peripheral face of a copper tube 1, and the front face of a fin 2, and can form it by installing it on this acrylic adhesion material binder film, as a silica gel particle is embedded. Moreover, the powder of silica gel is kneaded with water glass, and after extruding and applying this to the peripheral face of a copper tube 1, and the front face of a fin 2, desiccation baking of the part for water glass can be carried out, and adsorption material can be prepared by fixing silica gel powder and water glass on a fin front face etc. Anyway, what is necessary is just to fix by applying the powder or particle of adsorption material to the front face of a heat exchange member, or pasting up. As adsorption material, a zeolite, an activated alumina, etc. are out of silica gel.

[0012] Moreover, although the heat exchange member shown in drawing 1 is the heat-transfer element of a plate fin mold, the heat-transfer element of not only a such type thing but a shell and a tube mold, or an erotic fin mold etc. can also be used, and the heat-transfer element of the shape of single tubing which does not have a fin further may be used.

[0013] Next, actuation of the dry type air dryer of constituted this example is explained like drawing 1. The outside of tubing 1 is made to carry out conduction of the processed air which should be dehumidified, and the adsorption material 3 is made to contact. On the other hand, conduction of the refrigerant is carried out inside tubing 1. This refrigerant can use the cooling water (for example, 28 degrees C) supplied from the cooling tower currently installed in works etc.

[0014] If it does so, the moisture in processed air will be adsorbed by the adsorption material 3, and will be removed, and processed air will be dehumidified. Although the adsorption material 3 tends to carry out temperature up by this adsorption exothermic reaction, since this heat is transmitted to the refrigerant which carries out conduction of the inside of tubing 1 through a fin 2 and the heat exchange tubing 1 and it is carried away with this refrigerant, the fault temperature up of the adsorption material 3 is prevented.

[0015] Consequently, the temperature of the resurgent gas which adsorption effectiveness holds a high condition and supplies at the time of playback of the adsorption material 3 of the adsorption material 3 has also been lower than before enough. For this reason, energy of the heat source of resurgent gas can be lessened and a running cost can be reduced.

[0016] Drawing 2 is the block diagram showing the 2nd example of this invention. The heat exchange members 4 and 5 of the couple of the structure shown in drawing 1 are intercepted in airtight with a batch 12, and are installed. And the refrigerant supply source 6 which supplies water (a cooling tower etc. and 28 degrees C), and the warm temperature intermediation supply source 7 which supplies 80-degree C thermal wastewater are connected to the heat exchange tubing 1 of the heat exchange members 4 and 5 through piping 8 and 10. That is, piping 8 is connected to the refrigerant supply source 6, and this piping 8 is connected to the tubing 1 of the heat exchange members 4 and 5 through branch lines 8a and 8b, respectively. On the other hand, it connects with the warm temperature intermediation supply source 7 through piping 10 and branch lines 10a and 10b at the heat exchange tubing 1 of the heat exchange members 4 and 5, respectively. The closing motion valves 9a and 9b are formed in Piping 8a and 8b, respectively, and the closing motion valves 11a and 11b are formed in Piping 10a and 10b, respectively. As for the closing motion valves 9a, 9b, 11a, and 11b, the closing motion is controlled by the control unit (not shown).

[0017] Next, actuation of this example is explained. First, a control unit makes open the closing

motion valves 9a and 11b, and makes open the closing motion valves 9b and 11a. And conduction of the processed air is carried out to the outside surface side of the heat exchange member 4. [0018] If it does so, while processed air will be dehumidified by the adsorption material 3 of the heat exchange member 4, the adsorption material 3 is cooled with the refrigerant which carries out conduction of the inside of the tubing 1 of the heat exchange member 4, and the fault temperature up is prevented.

[0019] On the other hand, since about 80-degree C warm temperature intermediation supplied from the warm temperature intermediation supply source 7 in tubing of the heat exchange member 5 is carrying out conduction, the adsorption material 3 of this heat exchange member 5 is heated, carries out desorption of the moisture, and is reproduced. Thus, processed air is dehumidified in the heat exchange member 4, and the playback process of adsorption material is carried out in the heat exchange member 5.

[0020] Subsequently, the closing motion valves 9b and 11a are made open after playback process termination of the heat exchange member 5, and the closing motion valves 9a and 11b are made close. And conduction of the processed air is carried out to the outside surface of the heat exchange member 5.

[0021] If it does so, while warm temperature intermediation will carry out conduction of the inside of the tubing 1 of the heat exchange member 4 and desorption of the moisture with which the adsorption material 3 was adsorbed will be carried out, dehumidification processing of processed air is performed in the heat exchange member 5 by which the adsorption material 3 was reproduced.

[0022] Thus, processed air can be continuously dehumidified by switching supply of processed air, a refrigerant, and warm temperature intermediation by turns by the heat exchange member 4 and the heat exchange member 5. Also in this example, preventing the fault temperature up of the adsorption material 3, like the example of drawing 1, it is efficient and processed air can be dehumidified. Moreover, a running cost is also low.

[0023] Next, the dry type air dryer concerning the example of this invention is manufactured, and the engine performance is conventionally explained as compared with the case of the example of a comparison by equipment.

The conventional equipment of example \*\* of a comparison dehumidifies [ dry-type-] or dehumidifies [ wet-] at adsorption material using the honeycomb rotor of silica gel.

Processed air inlet condition dry-bulb temperature (it abbreviates to DB hereafter); (1) 32 degrees C, Relative humidity (it abbreviates to RH hereafter); 68% absolute-humidity  $x=20.8\text{g/kg'}$ , dew-point (it abbreviates to DP hereafter); -- 25-degree-C air-capacity; -- example refrigerant of 600m<sup>3</sup>/h(2) wet dehumidification; -- an R-22 or 5.5kW refrigerator -- using -- amount;of wet dehumidification dehumidification 7776 g/h outlet air condition;DB -- 15 degree C About 8000 kcal/h RH95%, DP14 degree C,  $x=10.0\text{ g/kg'}$ cooling energy; The example silica gel honeycomb rotor of air-cooling refrigerator quantity of electricity;about 6.0 kWh(s)(3) dry-type dehumidification, The diameter of 350mm, amount;of die-length 200mm dehumidification 4896 g/h outlet air condition;DB62 degree C, RH8.2%, DP19.5 degree C,  $x=14.0\text{ g/kg'}$ renewal energy; about 6300kcal playback quantity of electricity;about 7.3 kWh playback heat-source temperature;DB140 degree C [0024] The heat exchange member of the structure shown in example 1 drawing 1 was used. However, fin pitch;3.5mm, heat transfer area; the acrylic adhesiveness binder was applied all over 2x2 sets of 29m aluminum plate fins (5-minute batch change method), and 680g /of silica gels of 20-35 meshes of viscosity was installed two times m on the front face.

[0025] Moreover, dry type dehumidification was carried out at the process same on condition that 28 degrees C of cold energy intermediation; cooling tower water at the time of \*\* adsorption, and the warm temperature intermediation;80-degree-C thermal wastewater at the time of \*\* playback as a heat carrier of the section of copper as the example shown in drawing 2.

[0026] Consequently, the damp air of amount of dehumidification;10200 g/h outlet air condition;DB34 degree-C, RH19%, DP8 degree-C, and  $x=6.65\text{ g/kg'}$  was acquired.

[0027] In addition, the cooling tower water as cold energy intermediation is low-price cooling

water, and the thermal wastewater as warm temperature intermediation is also low-price wastewater. Therefore, a running cost becomes very low and is applicable also to dehumidification air conditioning as it is.

[0028] It applied by extrusion molding, desiccation baking was carried out, and the outside surface of example 2 copper tube (the outer diameter of 10mm, die length of 1200m) was made to fixing-size silica gel powder with water glass. Hard soldering welding of this copper tube was carried out at the tube plate, and the heat exchange member was obtained. The result equivalent to an example 1 was obtained also in this example 2.

[0029] In addition, as for this invention, it is needless to say that it is not limited to the above-mentioned example. For example, not only tubed but a tabular batch member is sufficient as a heat exchange member. Moreover, not only the inside of tubing but an outside may be made to carry out conduction of the heat carrier, and it may carry out conduction of the processed air into tubing.

[0030] Moreover, although the heat exchange member of the example of above-mentioned drawing 1 prepares adsorption material in the outside surface of the heat exchanger of a plate fin mold, it is applicable to the thing of various gestalten, such as an erotic fin mold which prepared the fin in the outside surface of shell with the shape not only of this plate fin mold but a pipe, a fin mold, and a pipe, as a heat exchange member. In addition, rather than the thing of the shape of a mere pipe, contact surface area with processed air becomes large, and the thing of a gestalt which has a fin can attain the miniaturization of a heat exchange member.

[0031]

[Effect of the Invention] As explained above, while according to this invention water adsorption material is prepared in a heat exchange member and this water adsorption material dehumidifies processed air, generation of heat from the adsorption material by adsorption of moisture can carry out dry type dehumidification of the processed air, maintaining the adsorption effectiveness of adsorption material highly, since heat exchange with the thermal fluid through a heat exchange member removed.

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#### DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the front view showing the example of this invention.

[Drawing 2] It is the block diagram showing other examples of this invention.

[Description of Notations]

1: Heat exchange tubing

2: Fin

3: Adsorption material

4 5: Heat exchange member

6: Refrigerant supply source

7: Warm temperature intermediation supply source

8, 8a, 8b, 10, 10a, 10b: Piping  
9a, 9b, 11a, 11b: Closing motion valve

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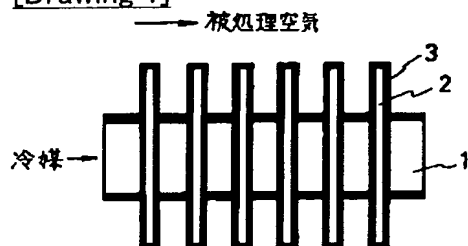
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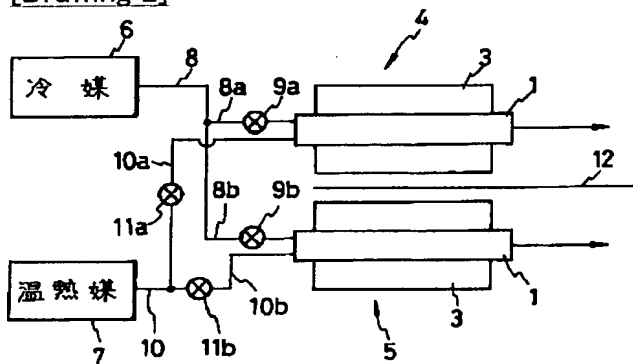
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## DRAWINGS

[Drawing 1]



[Drawing 2]



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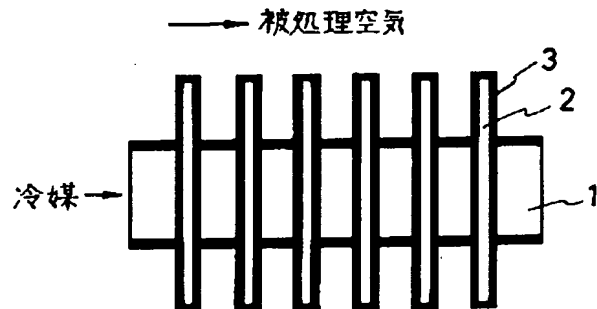
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(54)【発明の名称】 乾式除湿装置

(57)【要約】

【目的】 高湿度空気除湿する場合にも、吸着材の過昇温を防止することができ、吸着効率の低下を防止できると共に、再生温度を高くする必要がない乾式除湿装置を提供する。

【構成】 銅管1の外側には複数のフィン2が設けられており、銅管1の外周面及びフィン2には水分吸着材3が塗布されている。この熱交換部材の外側に被処理空気を通流させ、管1の内側に冷媒を通流させる。



## 【特許請求の範囲】

【請求項 1】 一表面に水分吸着材が配置された熱交換部材の前記一表面に被処理空気を通流させ、他の表面に熱媒流体を通流させることを特徴とする乾式除湿装置。

【請求項 2】 筒状の熱交換部材の外表面部分に水分吸着材を配置し、この外表面側に被処理空気を通流させ、前記熱交換部材の内側に熱媒流体を通流させることを特徴とする乾式除湿装置。

【請求項 3】 その外表面部分に水分吸着材を配置した少なくとも 2 個の筒状の熱交換部材と、これらの熱交換部材に対し、前記熱交換部材の外表面側に被処理空気を通流させその内側に冷媒を通流させる除湿工程と前記熱交換部材の内側に温熱媒を通流させる吸着材再生工程とを交互に行わせる制御手段とを有することを特徴とする乾式除湿装置。

【請求項 4】 前記吸着材は、シリカゲル、ゼオライト及び活性アルミナからなる群から選択した少なくとも 1 種であることを特徴とする請求項 1 乃至 3 のいずれか 1 項に記載の乾式除湿装置。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は吸着材を使用して被処理空気から除湿する乾式除湿装置に関し、特に高湿度空気の除湿に有効な乾式除湿装置に関する。

## 【0002】

【従来の技術】 空気中の水分を除去する除湿装置としては、空気を冷却して過飽和蒸気を除去する湿式除湿装置と、吸着材に水分を吸着させて低湿度化を図る乾式除湿装置とがある。湿式除湿装置においては、冷凍機により冷却した冷媒を使用して空気を冷却するものが一般的である。

【0003】 しかし、この冷凍機はフロンを使用しているため、近時の脱フロンの要請に反するものであり、また、凝縮熱が大きい水分を凝縮除去しようとするため、消費エネルギーが高いという問題点がある。また、凝縮した水分の凍水化を防止するために、冷却温度及び除湿領域には制約があるという難点がある。

【0004】 一方、乾式除湿装置においては、シリカゲル等の吸着材の水分吸着作用により、空気中の水分を除去するので、適用しようとする除湿領域に制約がない。このため、この乾式除湿装置は、近年適用分野が拡大している。

## 【0005】

【発明が解決しようとする課題】 しかしながら、従来の乾式除湿装置は、高湿度空気の除湿に適用した場合、水分の吸着反応が大きな発熱を伴うものであるため、被処理空気自体が高温になってしまうという問題点がある。このように、吸着材は水分の吸着により発熱するため、高温になって吸着効率が低下してしまう。また、吸着材を再生するためには被処理空気よりも高温の再生ガスを

吸着材に通す必要があるため、再生ガス用に高温の熱源が必要となり、ランニングコストが高いという難点がある。

【0006】 本発明はかかる問題点に鑑みてなされたものであって、高湿度空気を除湿する場合にも吸着材の過昇温を防止することができ、吸着効率の低下を防止できると共に、再生温度を従来に比して低下させることができる乾式除湿装置を提供することを目的とする。

## 【0007】

10 【課題を解決するための手段】 本発明に係る乾式除湿装置は、一表面に水分吸着材が配置された熱交換部材の前記一表面に被処理空気を通流させ、他の表面に熱媒流体を通流させることを特徴とする。

【0008】 また、本発明に係る他の乾式除湿装置は、筒状の熱交換部材の外表面部分に水分吸着材を配置し、この外表面側に被処理空気を通流させ、前記熱交換部材の内側に熱媒流体を通流させることを特徴とする。

20 【0009】 更に、本発明に係る更に他の乾式除湿装置は、その外表面部分に水分吸着材を配置した少なくとも 2 個の筒状の熱交換部材と、これらの熱交換部材に対し、前記熱交換部材の外表面側に被処理空気を通流させその内側に冷媒を通流させる除湿工程と前記熱交換部材の内側に温熱媒を通流させる吸着材再生工程とを交互に行わせる制御手段とを有することを特徴とする。

## 【0010】

30 【作用】 本発明においては、除湿工程にて、熱交換部材の水分吸着材が配置された側（一表面側又は外表面側）に、除湿せんとする被処理空気を通流させ、被処理空気中の水分を前記吸着材に吸着させて除湿する。一方、熱交換部材の他の表面側又は内側には熱媒流体を通流させて熱交換部材を介して前記吸着材から熱を奪う。これにより、吸着反応により発熱した吸着材が過度に昇温することが防止される。このため、吸着材の吸着効率の低下を防止できると共に、再生温度は従来のように高温にする必要がないので、再生ガスの熱源のランニングコストを低減することができる。

## 【0011】

40 【実施例】 以下、本発明の実施例について添付の図面を参照して具体的に説明する。図 1 は本発明の実施例に係る乾式除湿装置の熱交換部材を示す正面図である。熱交換管（銅管）1 には、複数のアルミニウムプレートフィン 2 が嵌合されている。そして、これらの銅管 1 の外周面及びフィン 2 の表面の全面に、水分吸着材 3 が配置されている。この吸着材 3 は、例えば銅管 1 の外周面及びフィン 2 の表面の全面にアクリル粘着性バインダを塗布し、このアクリル粘着材バインダ膜にシリカゲル粒子を埋め込むようにして、添着することにより形成することができる。また、シリカゲルの粉末を水ガラスと共に混練し、これを銅管 1 の外周面及びフィン 2 の表面に押出して塗布した後、水ガラス分を乾燥焼成し、シリカゲル

粉末と水ガラスをフィン表面等に固着することにより吸着材を設けることができる。いずれにしても、吸着材の粉末又は粒子を熱交換部材の表面に塗布し、又は接着することにより、固着すればよい。吸着材としては、シリカゲルの外に、ゼオライト及び活性アルミナ等がある。

【0012】また、図1に示す熱交換部材はプレートフィン型の熱交換素子であるが、このようなタイプのものに限らず、シェルアンドチューブ型又はエロフィン型の熱交換素子等を使用することもでき、更にフィンを有しない単管状の熱交換素子を使用してもよい。

【0013】次に、図1の如く構成された本実施例の乾式除湿装置の動作について説明する。除湿すべき被処理空気を管1の外側に流通させ、吸着材3と接触させる。一方、管1の内側には冷媒を流通させる。この冷媒は工場等に設置されているクーリングタワーから供給される冷却水（例えば28℃）を使用することができる。

【0014】そうすると、被処理空気中の水分は、吸着材3により吸着されて除去され、被処理空気が除湿される。この吸着発熱反応により吸着材3は昇温しようとするが、この熱はフィン2及び熱交換管1を介して管1内を流通する冷媒に伝達されて、この冷媒により運び去られるため、吸着材3の過昇温が防止される。

【0015】その結果、吸着材3は吸着効率が高い状態を保持し、吸着材3の再生時に供給する再生ガスの温度も従来より低いもので足りる。このため、再生ガスの熱源のエネルギーを少なくすることができ、ランニングコストを低減することができる。

【0016】図2は本発明の第2の実施例を示すブロック図である。図1に示す構造の一对の熱交換部材4、5が仕切12により気密的に遮断されて設置されている。そして、クーリングタワー等の例えば28℃の水を供給する冷媒供給源6と、例えば80℃の温排水を供給する温熱媒供給源7が配管8、10を介して熱交換部材4、5の熱交換管1に接続されている。即ち、冷媒供給源6には配管8が接続されており、この配管8は分岐配管8a、8bを介して夫々熱交換部材4、5の管1に接続されている。一方、温熱媒供給源7には配管10及び分岐配管10a、10bを介して夫々熱交換部材4、5の熱交換管1に接続されている。配管8a、8bには夫々開閉弁9a、9bが設けられており、配管10a、10bには夫々開閉弁11a、11bが設けられている。開閉弁9a、9b、11a、11bは制御装置（図示せず）によりその開閉が制御される。

【0017】次に、本実施例の動作について説明する。先ず、制御装置は開閉弁9a、11bを開、開閉弁9b、11aを開にする。そして、被処理空気を熱交換部材4の外側面に流通させる。

【0018】そうすると、被処理空気は熱交換部材4の吸着材3により除湿されると共に、吸着材3は熱交換部材4の管1内を流通する冷媒により冷却されてその過昇

温が防止される。

【0019】一方、熱交換部材5の管内には温熱媒供給源7から供給される約80℃の温熱媒が流通しているので、この熱交換部材5の吸着材3は加熱されて水分を脱着し、再生される。このように、熱交換部材4において被処理空気が除湿され、熱交換部材5においては、吸着材の再生工程が実施される。

【0020】次いで、熱交換部材5の再生工程終了後、開閉弁9b、11aを開、開閉弁9a、11bを閉にする。そして、熱交換部材5の外表面に被処理空気を流通させる。

【0021】そうすると、熱交換部材4の管1内を温熱媒が流通してその吸着材3に吸着されていた水分が脱着されると共に、吸着材3が再生された熱交換部材5においては、被処理空気の除湿処理が行われる。

【0022】このようにして、被処理空気、冷媒及び温熱媒の供給を熱交換部材4と熱交換部材5とで交互に切り換えることにより、被処理空気を連続的に除湿することができる。本実施例においても、図1の実施例と同様に、吸着材3の過昇温を防止しつつ、被処理空気を高効率で除湿することができる。また、ランニングコストも低い。

【0023】次に、本発明の実施例に係る乾式除湿装置を製造し、その性能を従来装置による比較例の場合と比較して説明する。

#### 比較例

この従来装置は、吸着材にシリカゲルのハニカムロータを使用して乾式除湿又は湿式除湿するものである。

#### (1) 被処理空気入口条件

乾球温度（以下、DBと略す）；32℃、

相对湿度（以下、RHと略す）；68%

絶対湿度  $x = 20.8 \text{ g/kg}$ 、

露点（以下、DPと略す）；25℃

風量；600  $\text{m}^3/\text{h}$

#### (2) 湿式除湿例

冷媒；R-22、

5.5KW冷凍機を用いて湿式除湿

除湿量；7776  $\text{g/h}$

出口空気条件；DB15℃、RH95%、DP14℃、

$x = 10.0 \text{ g/kg}$

冷却エネルギー；約8000  $\text{kcal/h}$

空冷冷凍機電力量；約6.0  $\text{kWh}$

#### (3) 乾式除湿例

シリカゲルハニカムロータ、直径350mm、長さ200mm

除湿量；4896  $\text{g/h}$

出口空気条件；DB62℃、RH8.2%、DP19.5℃、

$x = 14.0 \text{ g/kg}$

再生エネルギー；約6300  $\text{kcal}$

再生電気量：約7.3kWH

再生熱源温度：DB140℃

#### 【0024】実施例1

図1に示す構造の熱交換部材を使用した。但し、フィンピッチ：3.5mm、伝熱面積：29m<sup>2</sup>×2基（5分バッチ切り替え方式）のアルミプレートフィンの全面にアクリル粘着性バインダーを塗布し、その表面に粘度20～35メッシュのシリカゲルを680g/m<sup>2</sup>添着した。

【0025】また、銅管内部の熱媒として、①吸着時の冷熱媒；クーリングタワー水28℃、②再生時の温熱媒；80℃温排水の条件で、図2に示す実施例と同様の工程で乾式除湿した。

【0026】その結果、除湿量：10200g/h  
出口空気条件：DB34℃、RH19%、DP8℃、  
x=6.65g/kg  
の低湿空気が得られた。

【0027】なお、冷熱媒としてのクーリングタワー水は低価格冷却水であり、温熱媒としての温排水も低価格排水である。よって、ランニングコストは極めて低くなり、そのまま除湿空調にも使用することができる。

#### 【0028】実施例2

銅管（外径10mm、長さ1200m）の外表面にシリカゲル粉を水ガラスと共に押出成形により塗布し、乾燥焼成して固着化させた。この銅管を管板に口付溶接して熱交換部材を得た。この実施例2においても実施例1と同等の結果が得られた。

【0029】なお、本発明は上記実施例に限定されないことは勿論である。例えば、熱交換部材は筒状に限らず、板状の仕切部材でもよい。また、熱媒体は管の内側＊30

＊に限らず、外側に通流させ、被処理空気を管内に通流させてもよい。

【0030】また、上記図1の実施例の熱交換部材はプレートフィン型の熱交換器の外表面に吸着材を設けたものであるが、熱交換部材としては、このプレートフィン型に限らず、パイプ状のままのシェルアンドフィン型及びパイプの外表面にフィン設けたエロフィン型等、種々の形態のものに適用することができる。なお、フィン有する形態のものの方が、単なるパイプ状のものよりも被処理空気との接触面積が大きくなり、熱交換部材の小型化を図ることができる。

#### 【0031】

【発明の効果】以上説明したように、本発明によれば、熱交換部材に水分吸着材を設け、この水分吸着材により被処理空気を除湿すると共に、水分の吸着による吸着材からの発熱は、熱交換部材を介する熱媒流体との熱交換により除去するので、吸着材の吸着効率を高く維持したまま、被処理空気を乾式除湿することができる。

#### 【図面の簡単な説明】

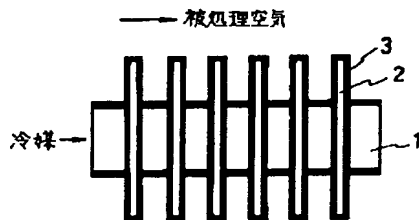
【図1】本発明の実施例を示す正面図である。

【図2】本発明の他の実施例を示すブロック図である。

#### 【符号の説明】

- 1：熱交換管
- 2：フィン
- 3：吸着材
- 4、5：熱交換部材
- 6：冷媒供給源
- 7：温熱媒供給源
- 8、8a、8b、10、10a、10b：配管
- 9a、9b、11a、11b：開閉弁

【図1】



【図2】

